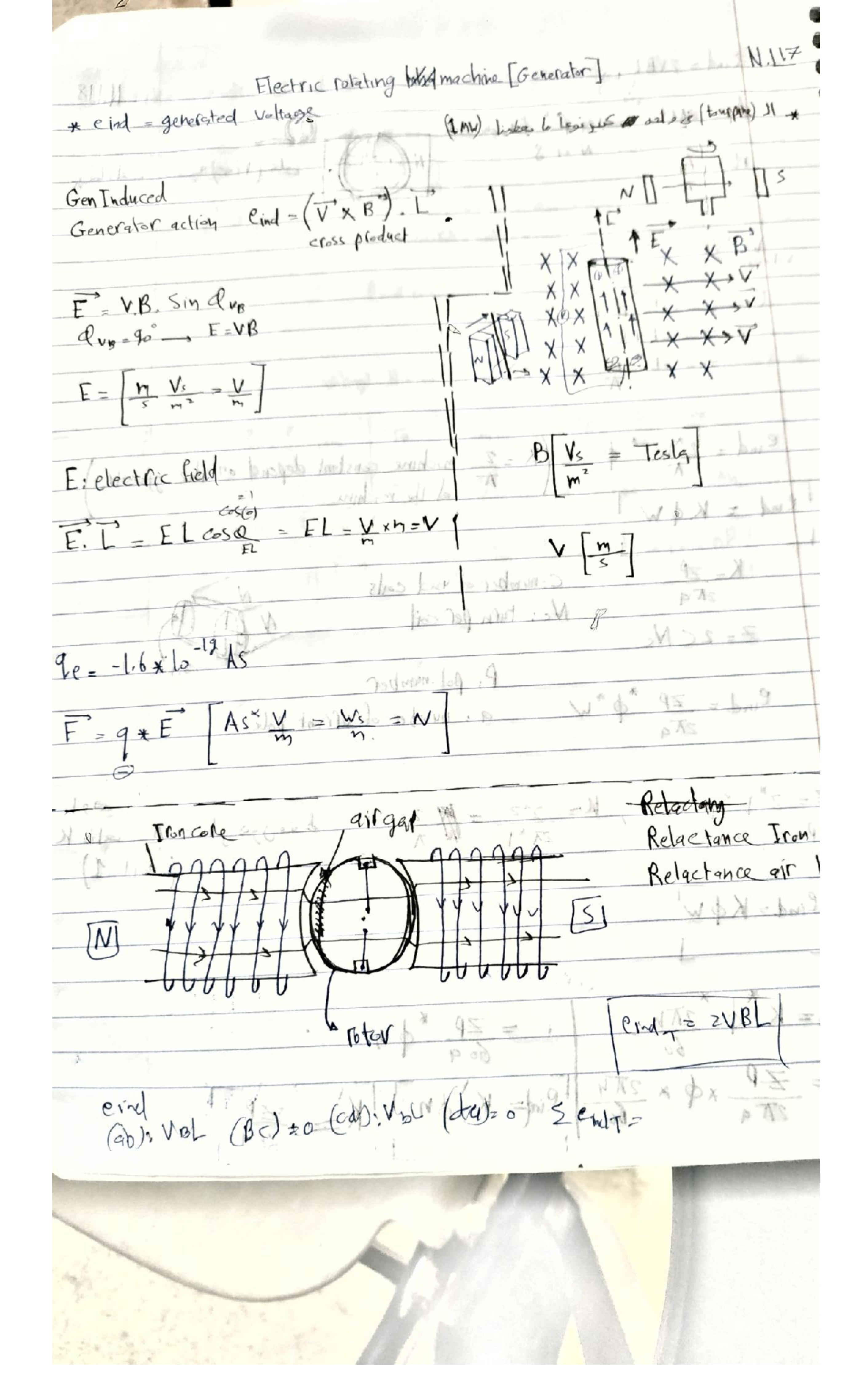


N.117

Electric rotating ~~...~~ machine [Generator]

* e_{ind} = generated voltage

* ال (tourpine) في محطه كبيرة نوعا ما بيعطيك (1MW)

Gen Induced

Generator action $e_{ind} = (\vec{V} \times \vec{B}) \cdot \vec{L}$

cross product

$\vec{E} = V.B. \sin \alpha_{VB}$

$\alpha_{VB} = 90^\circ \longrightarrow E = VB$

$E = \left[\frac{m}{s} \frac{Vs}{m^2} = \frac{V}{m}\right]$

E: electric field

$\vec{E} \cdot \vec{L} = E L \cos \alpha_{EL} = EL = \frac{V}{m} \times m = V$ ($\cos(0) = 1$)

$B \left[\frac{Vs}{m^2} = \text{Tesla}\right]$

$V \left[\frac{m}{s}\right]$

$q_e = -1.6 * 10^{-19}$ As

$\vec{F} = q * \vec{E} \left[As * \frac{V}{m} = \frac{Ws}{m} = N\right]$

~~Relactang~~

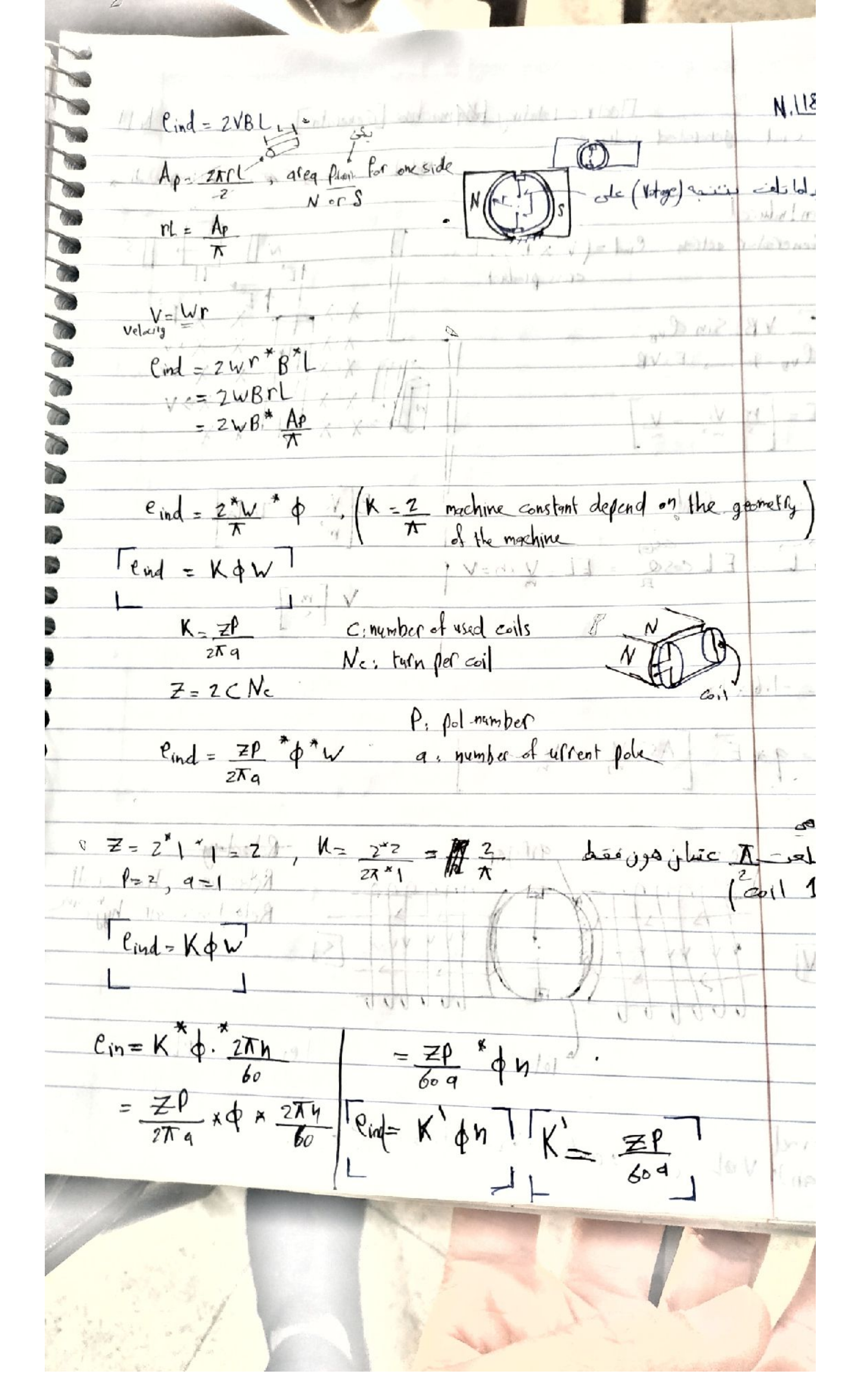
Relactance Iron

Relactance air

$e_{ind_T} = 2VBL$

e_{ind}

(ab): VBL (Bc) = 0 (cd): V_bL (da) = 0 $\sum e_{ind_T}$ =



$e_{ind} = 2VBL$

$A_p = \frac{2\pi r L}{2}$, area for one side (يعني) N or S

$rL = \frac{A_p}{\pi}$

... لما نلف بنتج (Voltage) على

$V = \omega r$ (Velocity)

$e_{ind} = 2\omega r^* B^* L$

$= 2\omega B r L$

$= 2\omega B^* \frac{A_p}{\pi}$

$e_{ind} = \frac{2^* \omega}{\pi} {}^* \phi$, ($K = \frac{2}{\pi}$ machine constant depend on the geometry of the machine)

$$e_{ind} = K\phi\omega$$

$K = \frac{ZP}{2\pi a}$

C: number of used coils

N_c: turn per coil

$Z = 2CN_c$

P: pol number

a: number of current pole

$e_{ind} = \frac{ZP}{2\pi a} {}^*\phi^*\omega$

$Z = 2^*1^*1 = 2$, $K = \frac{2^*2}{2\pi^*1} = \frac{2}{\pi}$ ... $\frac{\pi}{2}$ عشان هون فقط (coil 1

$P = 2$, $a = 1$

$$e_{ind} = K\phi\omega$$

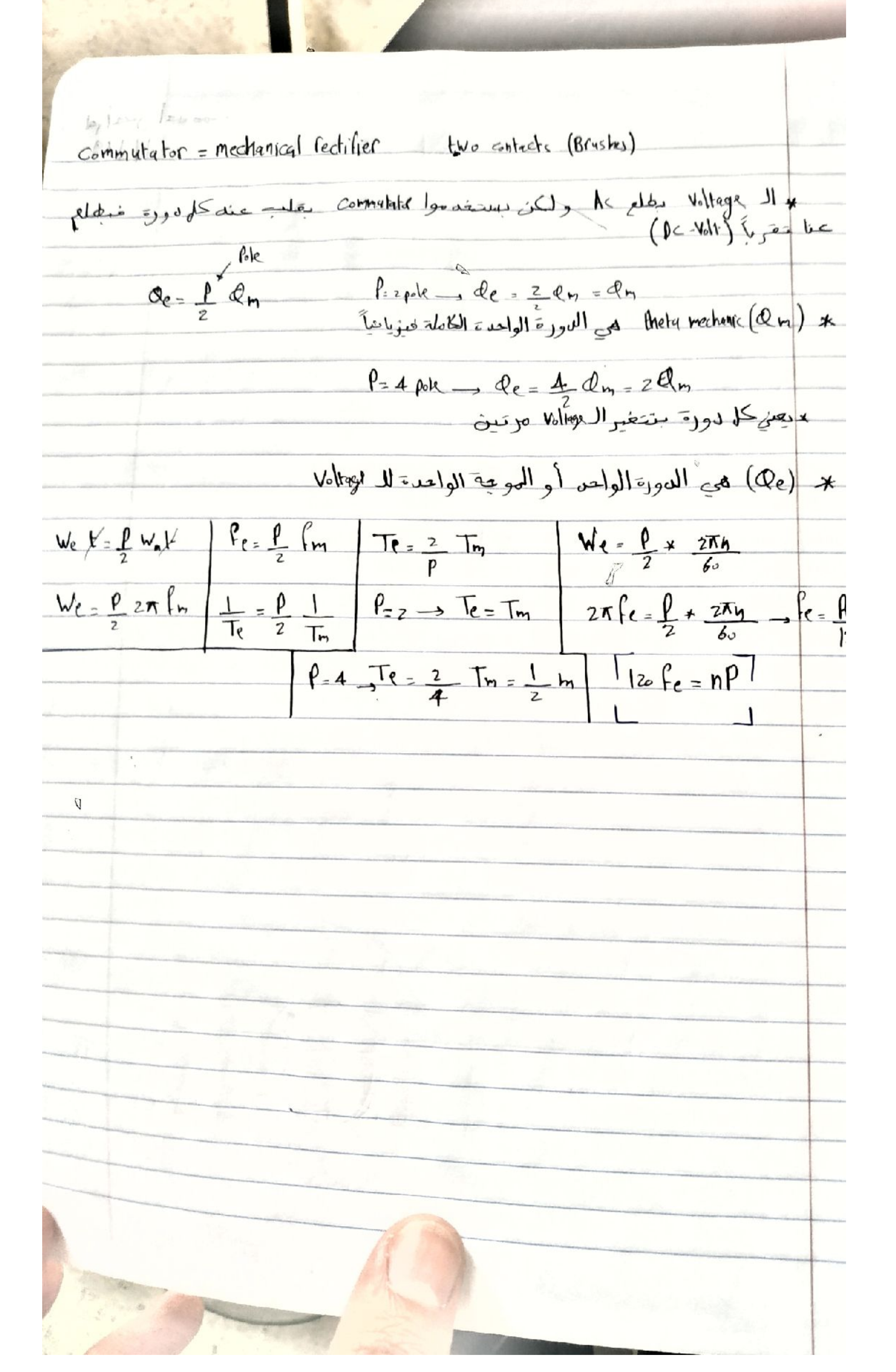
$e_{in} = K^* \phi^* \frac{2\pi n}{60}$

$= \frac{ZP}{2\pi a} \times \phi \times \frac{2\pi n}{60}$

$= \frac{ZP}{60a} {}^* \phi n$

$$e_{ind} = K'\phi n$$

$$K' = \frac{ZP}{60a}$$



Commutator = mechanical rectifier   two contacts (Brushes)

* ال Voltage بطلع Ac ولكن بستخدموا Commutator بقلب عند كل دورة فبطلع عنا تقريباً (DC-Volt)

$\theta_e = \frac{P}{2}\theta_m$ (P: Pole)

$P = 2$ pole $\rightarrow \theta_e = \frac{2}{2}\theta_m = \theta_m$

* (θ_m) theta mechanic هي الدورة الواحدة الكاملة فيزيائياً

$P = 4$ pole $\rightarrow \theta_e = \frac{4}{2}\theta_m = 2\theta_m$

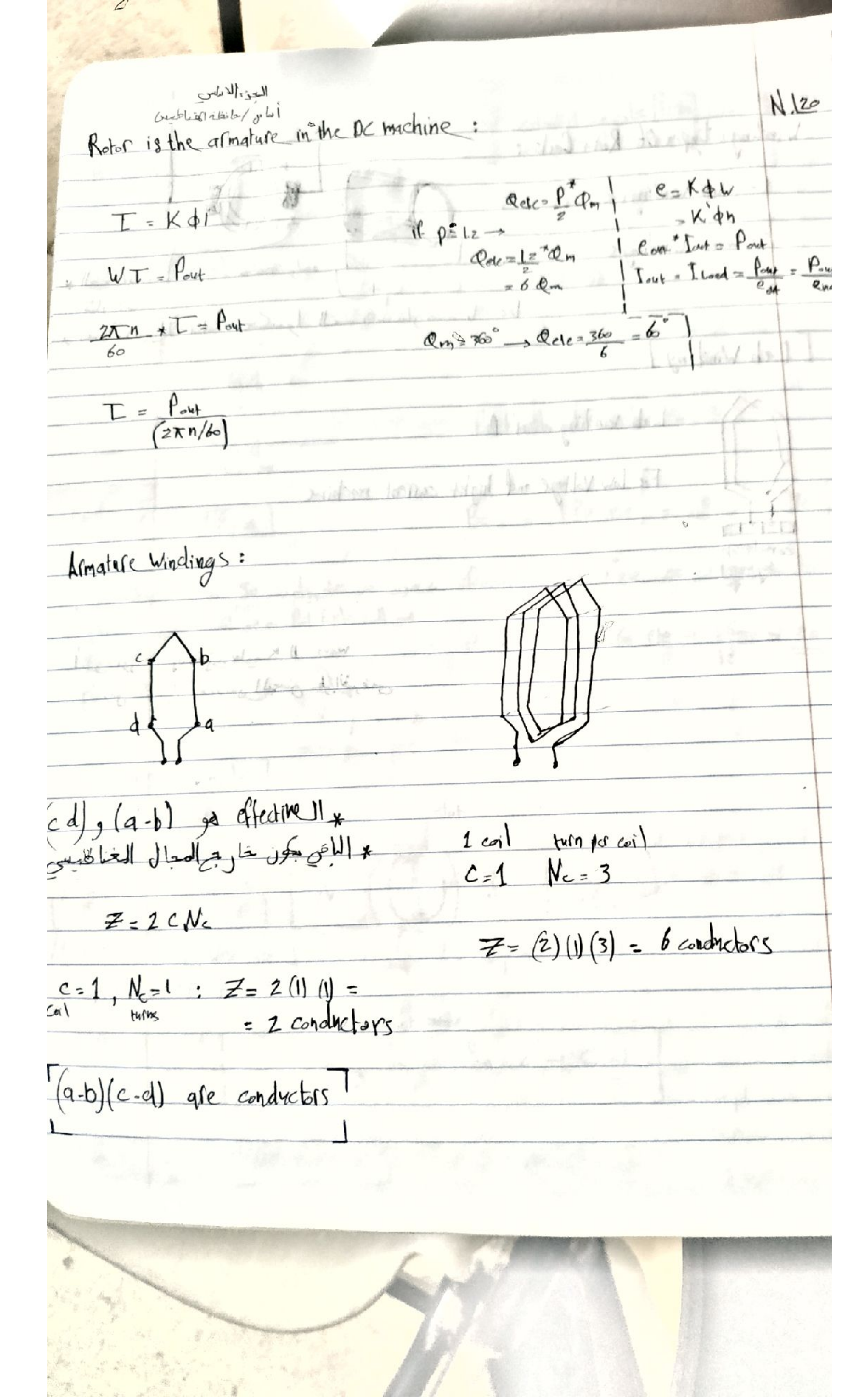
* يعني كل دورة بتتغير ال Voltage مرتين

* (θ_e) هي الدورة الواحدة أو الموجة الواحدة لل Voltage

$\omega_e t = \frac{P}{2}\omega_m t$ | $f_e = \frac{P}{2} f_m$ | $T_e = \frac{2}{P} T_m$ | $\omega_e = \frac{P}{2} * \frac{2\pi n}{60}$

$\omega_e = \frac{P}{2} 2\pi f_m$ | $\frac{1}{T_e} = \frac{P}{2}\frac{1}{T_m}$ | $P = 2 \rightarrow T_e = T_m$ | $2\pi f_e = \frac{P}{2} * \frac{2\pi n}{60} \rightarrow f_e = \frac{P}{…}$

$P = 4 \rightarrow T_e = \frac{2}{4} T_m = \frac{1}{2} T_m$ | $120 f_e = nP$



الجزء الاساسي

أساس / طاقة الكهرطيسي

Rotor is the armature in the DC machine :

$T = K\phi I$

$WT = P_{out}$

$\frac{2\pi n}{60} * T = P_{out}$

$T = \frac{P_{out}}{(2\pi n/60)}$

$\theta_{ele} = \frac{P}{2} * \theta_m$

if $P = 12 \rightarrow$

$\theta_{ele} = \frac{12}{2} * \theta_m$

$= 6\,\theta_m$

$e = K\phi w$

$= K' \phi n$

$e_{out} * I_{out} = P_{out}$

$I_{out} = I_{Load} = \frac{P_{out}}{e_{out}} = \frac{P_{out}}{e_{in}}$

$\theta_m = 360° \longrightarrow \theta_{ele} = \frac{360}{6} = 60°$

Armature Windings :

* (c d), (a-b) هو الeffective
* الباقي بكون خارج المجال المغناطيسي

$Z = 2\,C\,N_c$

$C = 1$ (coil), $N_c = 1$ (turns) : $Z = 2(1)(1) =$

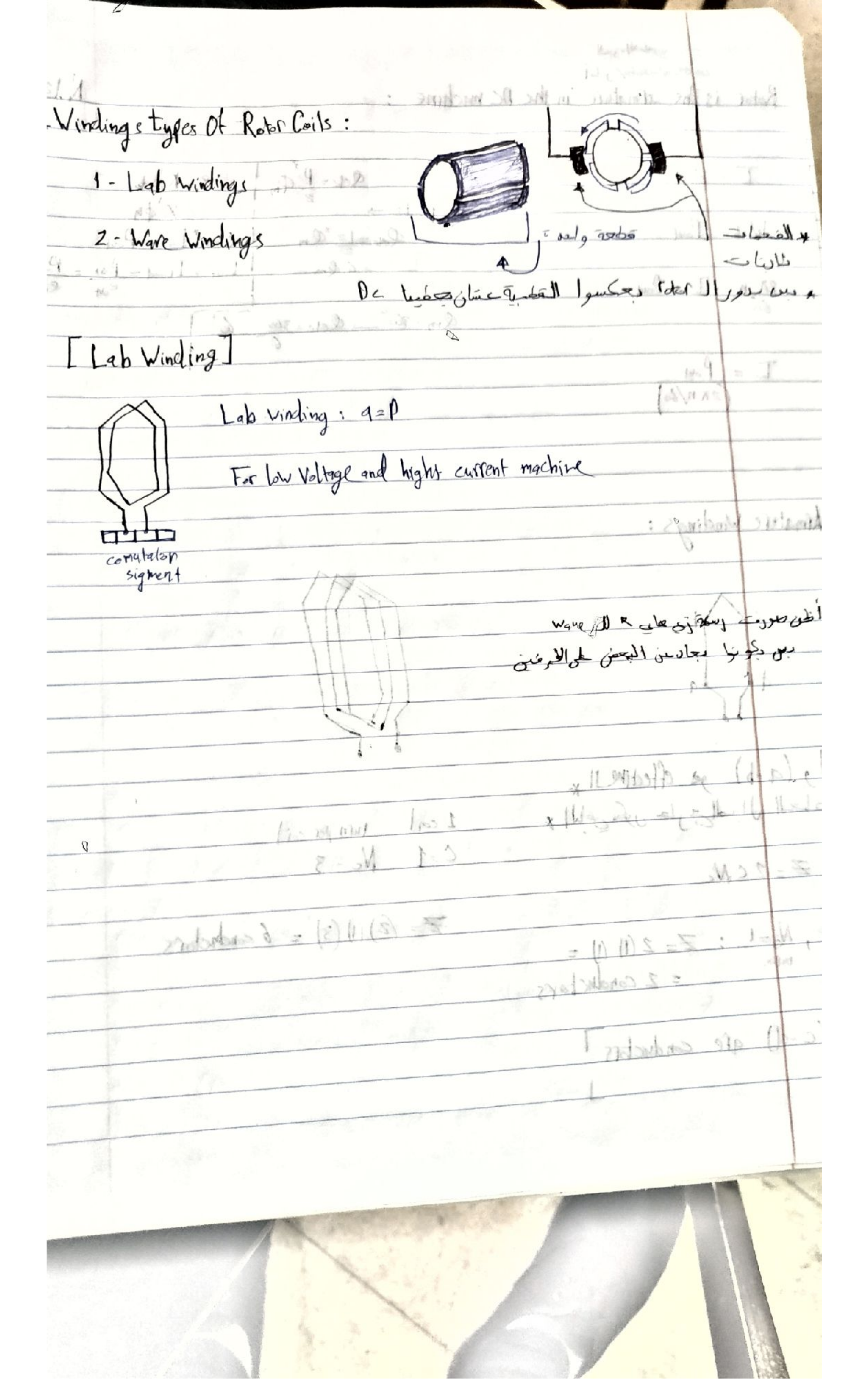
$= 2$ conductors

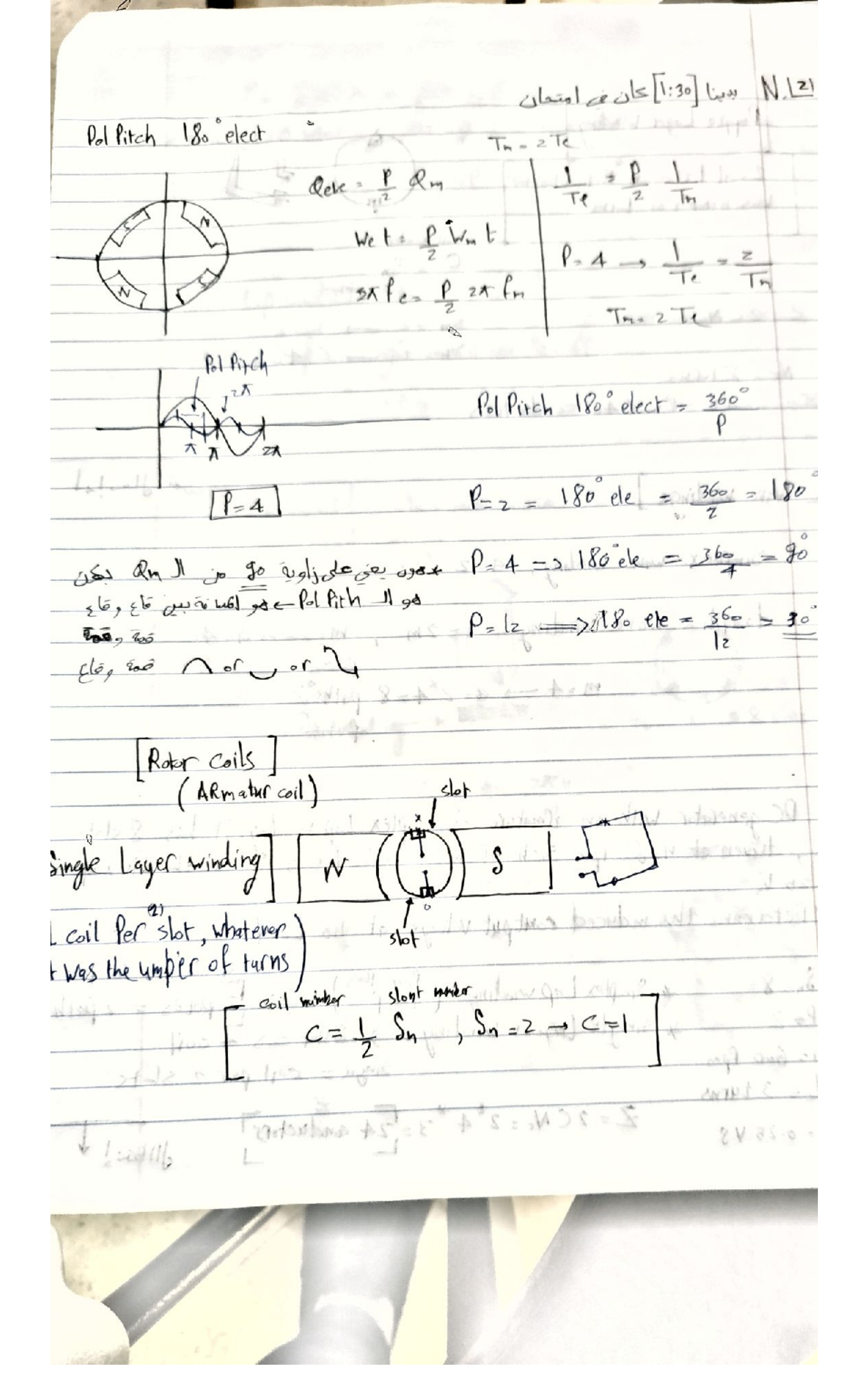
1 coil turn per coil

$C = 1 \quad N_c = 3$

$Z = (2)(1)(3) = 6$ conductors

[(a-b)(c-d) are conductors]


Windings types Of Rotor Coils :
1 - Lab windings
2 - Wave Windings
قطعة واحدة
* الفحمات ثابتات
* مين بيدور الـ rotor بيعكسوا القطبية عشان يطلعها DC
[Lab Winding]
Lab winding : a=P
For low Voltage and hight current machine
comutator sigment
أظن صورت رسمة زي هاي لل wave
بس بكونوا بعاد عن البعض على الأطراف



N. 21 بدينا [1:30] كان في امتحان

Pol Pitch 180° elect

$\theta_{ele} = \frac{P}{2} \theta_m$

$W_e t = \frac{P}{2} W_m t$

$2\pi f_e = \frac{P}{2} 2\pi f_m$

$T_m = 2 T_e$

$\frac{1}{T_e} = \frac{P}{2} \frac{1}{T_m}$

$P = 4 \rightarrow \frac{1}{T_e} = \frac{2}{T_m}$

$T_m = 2 T_e$

$\boxed{P = 4}$

Pol Pitch 180° elect $= \frac{360°}{P}$

$P = 2 = 180°$ ele $= \frac{360}{2} = 180°$

$P = 4 \Rightarrow 180°$ ele $= \frac{360}{4} = 90°$

$P = 12 \Longrightarrow 180$ ele $= \frac{360}{12} = 30°$

بكون يعني على زاوية 90 من ال θ_m
هو ال Pol Pith ← هو المسافة بين قاع وقاع
قمة و قمة
قمة وقاع ∩ or ∪ or ∿

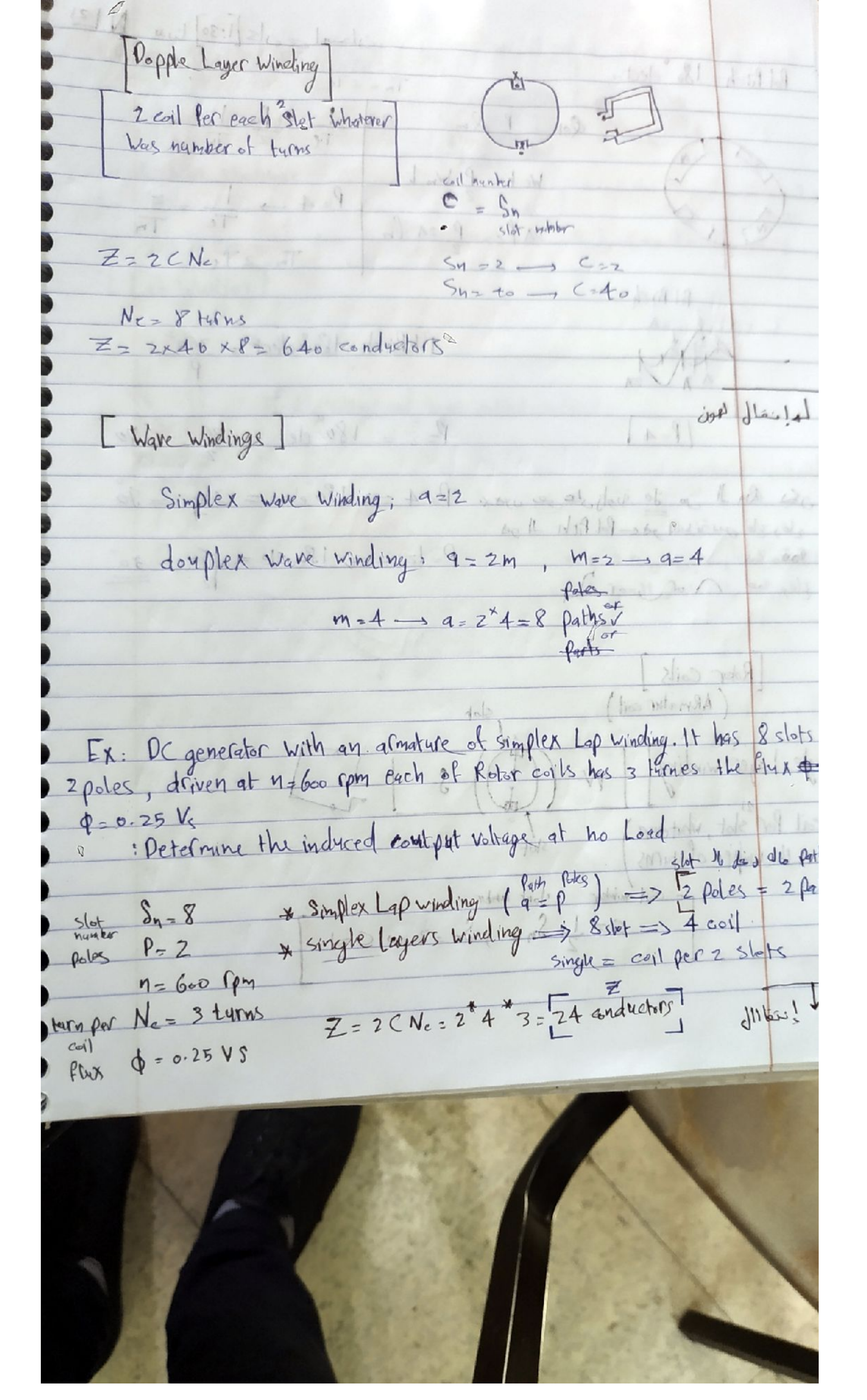
[Rotor Coils]
(ARmatur coil)

[Single Layer winding]

(1 coil Per slot, whatever it was the umber of turns)

$$\left[C = \frac{1}{2} S_n , \; S_n = 2 \rightarrow C = 1 \right]$$

(coil number, slont number)



[Dopple Layer Winding]

[2 coil per each 2 slot whatever was number of turns]

coil number: $C = S_n$ (slot number)

$S_n = 2 \rightarrow C = 2$

$S_n = 40 \rightarrow C = 40$

$Z = 2 C N_c$

$N_c = 8$ turns

$Z = 2 \times 40 \times 8 = 640$ conductors

لو إشتغال الموجة

[Wave Windings]

Simplex wave winding; $a = 2$

douplex wave winding; $a = 2m$, $m = 2 \rightarrow a = 4$

$m = 4 \rightarrow a = 2 * 4 = 8$ paths ~~poles~~ or ~~parts~~

Ex: DC generator with an armature of simplex Lap winding. It has 8 slots, 2 poles, driven at $n = 600$ rpm each of Rotor coils has 3 turnes the flux ϕ, $\phi = 0.25$ Vs

: Determine the induced output voltage at no Load

slot number: $S_n = 8$

poles: $P = 2$

$n = 600$ rpm

turn per coil: $N_c = 3$ turns

flux: $\phi = 0.25$ VS

* Simplex Lap winding ($a = p$, path = poles) $\Rightarrow$ [2 poles = 2 pa...

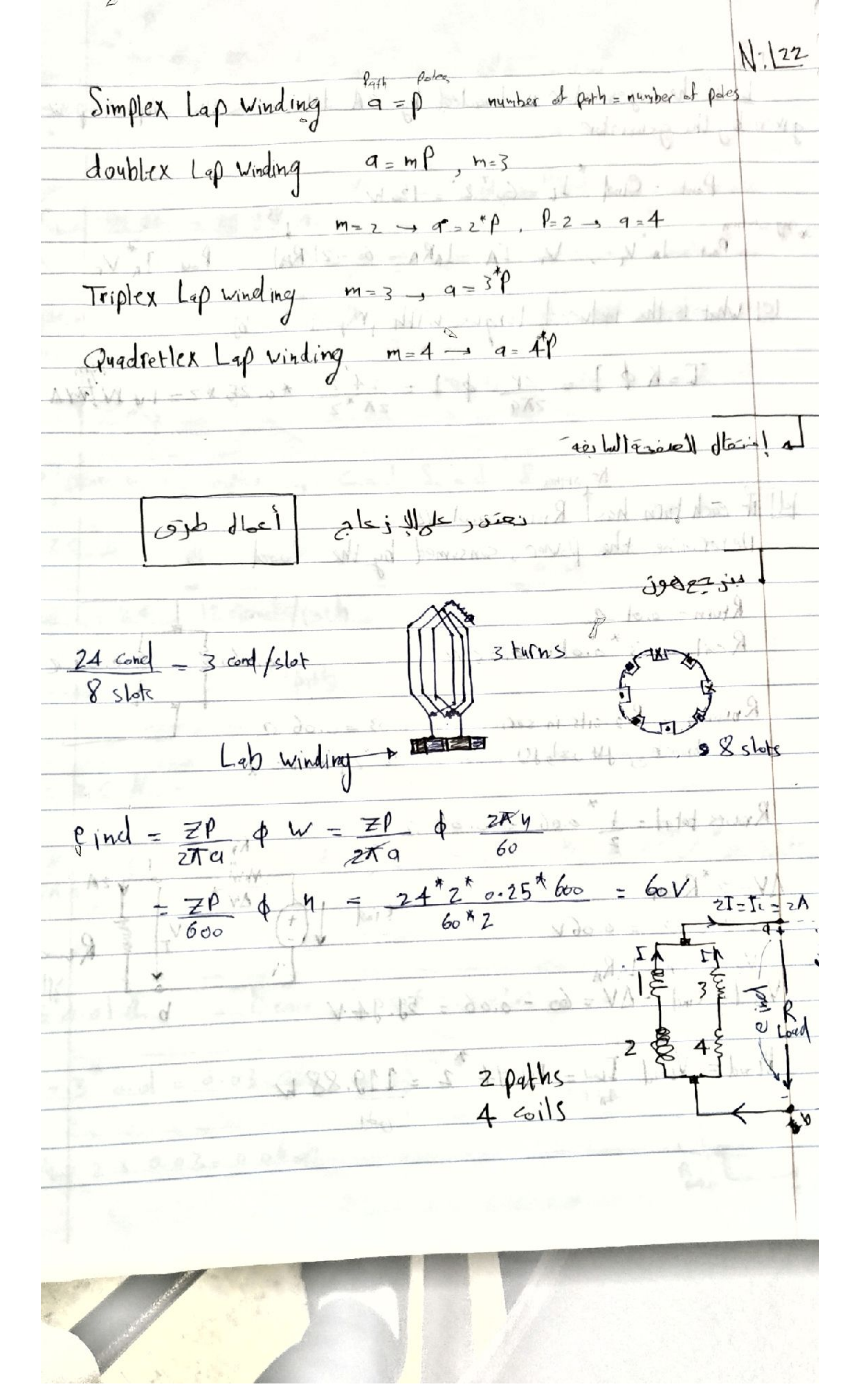
slot ... path

* single layers winding $\Rightarrow$ 8 slot $\Rightarrow$ 4 coil

single = coil per 2 slots

$Z = 2 C N_c = 2 * 4 * 3 = [24$ conductors$]$

بالتالي!



N: L22

Simplex Lap winding $a = P$ (path, poles) number of path = number of poles

doublex Lap winding $a = mP$, $m = 3$

$m = 2 \rightarrow a = 2 * P$, $P = 2 \rightarrow a = 4$

Triplex Lap winding $m = 3 \rightarrow a = 3 * P$

Quadretlex Lap winding $m = 4 \rightarrow a = 4 * P$

له إشتقاق الصفحة السابقة

أعطال طرق — نعتمد على الإزعاج

بنرجعلو

$\frac{24 \text{ cond}}{8 \text{ slots}} = 3 \text{ cond/slot}$

3 turns

Lab winding

8 slots

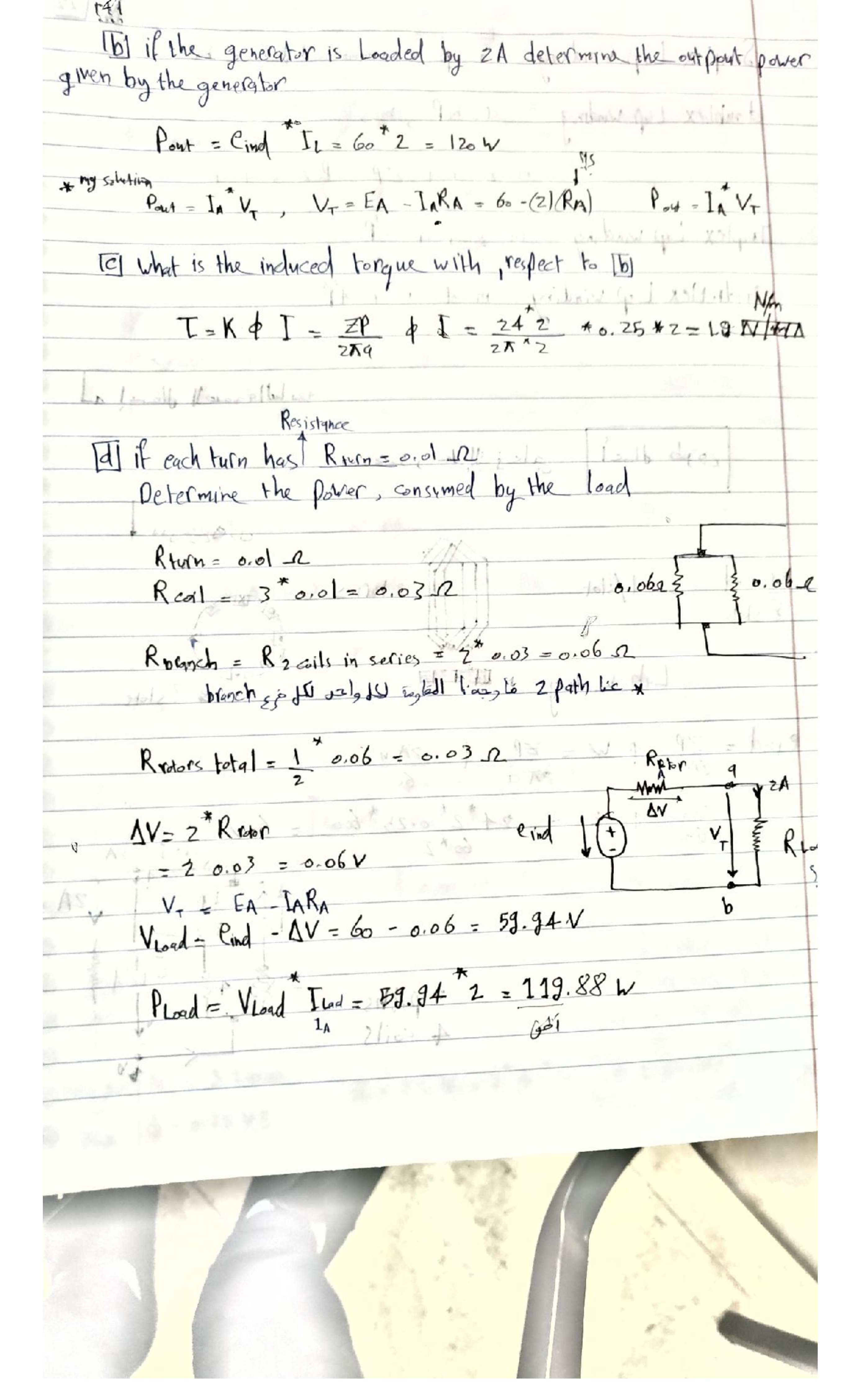
$$e_{ind} = \frac{ZP}{2\pi a} \phi w = \frac{ZP}{2\pi a} \phi \frac{2\pi n}{60}$$

$$= \frac{ZP}{60a} \phi n = \frac{24 * 2 * 0.25 * 600}{60 * 2} = 60V$$

$2I = I_L = 2A$

e_{ind}, R_{Load}, 1, 2, 3, 4

2 paths
4 coils


[b] if the generator is Loaded by 2A determine the output power given by the generator

$P_{out} = e_{ind} * I_L = 60 * 2 = 120\ W$

* my solution
$P_{out} = I_A * V_T$, $V_T = E_A - I_A R_A = 60 - (2)(R_A)$ $P_{out} = I_A * V_T$

[c] what is the induced torque with respect to [b]

$T = K \phi I = \frac{ZP}{2\pi a} \phi I = \frac{24 * 2}{2\pi * 2} * 0.25 * 2 = 1.9\ N/m$

Resistance
[d] if each turn has $R_{turn} = 0.01\ \Omega$
Determine the power consumed by the load

$R_{turn} = 0.01\ \Omega$
$R_{coil} = 3 * 0.01 = 0.03\ \Omega$

0.06 Ω   0.06 Ω

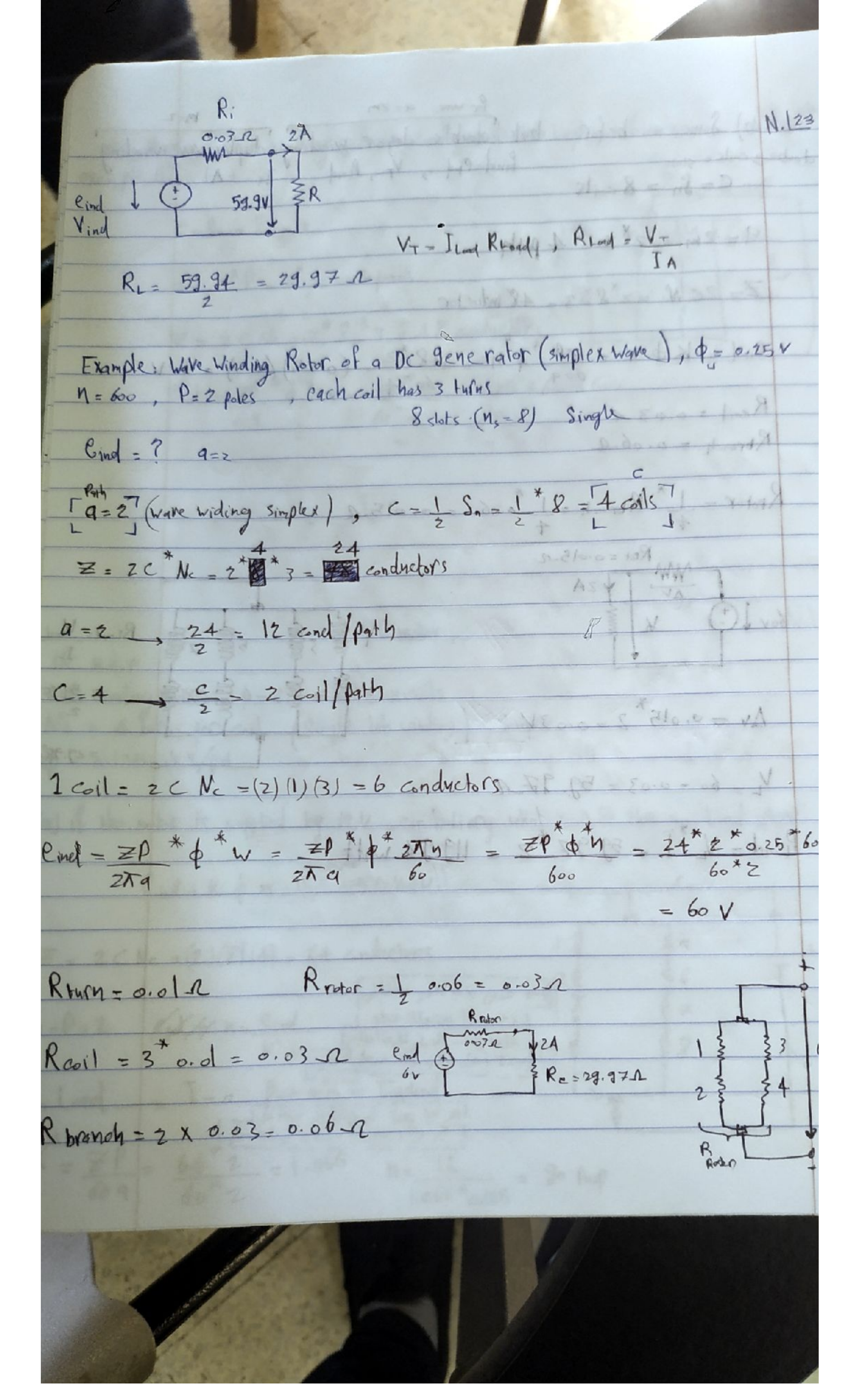
$R_{branch} = R_{2\ coils\ in\ series} = 2 * 0.03 = 0.06\ \Omega$
* بما انه 2 path فهيكون الموصلين على التوازي كل branch

$R_{rotors\ total} = \frac{1}{2} * 0.06 = 0.03\ \Omega$

R_{rotor}
ΔV
a
2A
e_{ind}
V_T
R_{Load}
b

$\Delta V = 2 * R_{rotor}$
$= 2\ 0.03 = 0.06\ V$
$V_T = E_A - I_A R_A$
$V_{Load} = e_{ind} - \Delta V = 60 - 0.06 = 59.94\ V$

$P_{Load} = V_{Load} * I_{Load} = 59.94 * 2 = 119.88\ W$
أقل



$V_T = I_{Load} R_{Load}$, $R_{Load} = \frac{V_T}{I_A}$

$R_L = \frac{59.94}{2} = 29.97\ \Omega$

Example: Wave Winding Rotor of a DC generator (simplex wave), $\phi = 0.25$ V

$n = 600$, $P = 2$ poles , each coil has 3 turns

8 slots ($n_s = 8$) Single

$e_{ind} = ?$ $a = 2$

$a = 2$ (Path) (wave widing simplex) , $C = \frac{1}{2} S_n = \frac{1}{2} * 8 = 4$ coils (C)

$Z = 2C * N_c = 2 * 4 * 3 = 24$ conductors

$a = 2 \longrightarrow \frac{24}{2} = 12$ cond / path

$C = 4 \longrightarrow \frac{C}{2} = 2$ coil / path

1 coil $= 2 C N_c = (2)(1)(3) = 6$ conductors

$$e_{ind} = \frac{ZP}{2\pi a} * \phi * w = \frac{ZP}{2\pi a} * \phi * \frac{2\pi n}{60} = \frac{ZP * \phi * n}{600} = \frac{24 * 2 * 0.25 * 60}{60 * 2}$$

$= 60$ V

$R_{turn} = 0.01\ \Omega$ $R_{rotor} = \frac{1}{2}\ 0.06 = 0.03\ \Omega$

$R_{coil} = 3 * 0.01 = 0.03\ \Omega$

$R_{branch} = 2 \times 0.03 = 0.06\ \Omega$